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Skin Disorder Diagnosis through Soft Computing: A Comprehensive Overview

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***Abstract*— In the modern world, skin conditions and lesions have risen to the top of the list of illnesses that affect individuals of all ages. Bacterial skin infections, fungal skin infections, eczema, and scabies are common skin diseases that individuals over the world experience, but especially so in underdeveloped nations. The traditional approach for diagnosing skin cancer is through biopsies. The skin is removed or scraped off, and the subject then goes through a series of laboratory tests. A type of category of illnesses known as skin disorders divides the various states of the skin's cells into hierarchical levels of development. Death may occur if the sickness is not contained as it spreads. Skin diseases are brought on by a variety of internal and environmental variables, including dietary differences, different organisms' cells, hormonal imbalances, and immune system disorders. In this paper we are comprehensive overview of skin disorder diagnosis through soft computing using ANN, SVM and Image Processing-Based Technique Also brief work about our research methodology and related work of skin disorders.**

***Index Terms*— ANN, SVM, Skin Diseases, Image Processing-Based Technique.**

I. INTRODUCTION

Skin cancer is a fatal disease that affects the skin. The form of skin cancer might be benign or aggressive. Moles on the skin simply seem as benign melanoma. The symptoms of malignant melanoma include bleeding sores. Malignant the most deadly type of skin cancer is melanoma. It develops from a pigmented skin lesion that has malignant development. It is a disorder that starts in skin's melanocytes and spreads gradually [1]. Other than second skin disease, acne is a less prevalent sort of skin condition. However, if it is not discovered in the early stages of the disease, it is extremely dangerous and fatal. It raises the percentage of mortality from skin cancer up to (75%) of all deaths. According to American Cancer Society forecasts, there will be an increase of more than 76000 new instances of skin illness in 2014. Less than 7% of occurrences of skin cancer are caused by this less frequent kind of skin illness. However, because it has a higher propensity to metastasis than other skin tumors, it is by far the most dangerous.2. Types of Question Answering System: Due to this trait, psoriasis and acne are the most deadly types of skin cancer (melanoma is predicted to be the cause of more than 75% of skin cancer-related fatalities in 2012) [2]. However, this particular skin condition has been regarded as among the most dangerous because it is dangerous and its prevalence has been gradually rising over time. Another disorder that affects the skin cells is acne. To quantitatively represent this state in photographs taken with a regular camera, a structure of High Level Intuitive Features (HLIFs) is provided. Whiteheads, blackheads, red, inflamed areas, and other acne-

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related skin conditions commonly affect the face and shoulders. With rising rates and subjectivity in various types of current clinical skin detection methods, psoriasis is the dangerous and harmful form of skin disease. As a result, Skin disease detection decision support systems are required, of which feature extraction is a crucial and valuable step. Standard camera images have lower and higher limits on their capacity to detect diseases since they are low-level characteristics that exist in high-dimensional image feature spaces, if we analyse the existing features of the set of photos for analysis. In [3] Images using several applications of the ABCD-rule for skin diseases a novel practical method for the early identification and detection of skin diseases is dermatoscopy. Dermatologists frequently employ matrices like the ABCD [4] or the seven-point checklist [5] (Skin asymmetry, border irregularity, colour patterns, and region's diameter). It provides an introduction to the 7-point checklist algorithm, which is an algorithm for detecting skin diseases like acne and psoriasis [6]. The symmetry is used, but it's highly objective and subjective, which causes a lot of variation in the observations [7]. Acne prevalence is on the rise, and systematic objective decision support systems can help meet the need while lowering subjectivity. A few of the current clinically employed detection dermoscopy, multispectral imaging, thermal imaging, and hyper spectral imaging are examples of approaches, to mention a few. Currently used electromagnetic, acoustic, and mechanical waves are used in skin imaging techniques [8].

II. Literature Survey

Numerous authors are producing intriguing results using a variety of methods and classifiers:

Kumar et al.'s computer-based detection method, described in their study [9], utilizes image processing techniques and artificial intelligence. The process involves several stages, including collecting dermoscopic images, filtering them to eliminate hair and noise, segmenting the images using a Maximum Entropy Threshold value, extracting features using GLCM (Gray-Level Co-occurrence Matrix), and finally, classifying the images using the KNN (K-Nearest Neighbours) algorithm.

C. Barata and colleagues introduced a comprehensive approach in their work [10], which revolves around leveraging a Computer-Aided Design (CAD) tool equipped with a multifaceted set of functionalities. This tool not only facilitates picture acquisition but also encompasses image processing, feature extraction, and diagnostic capabilities. Their proposed methodology lays the foundation for a robust framework designed to enhance various aspects of the research.

In this research paper, K. K. Singh et al. [11] present a comprehensive methodology for evaluating the efficacy of picture histogram equalization. This approach involves the utilization of an image's Gray Level Co-occurrence Matrix (GLCM) as a pivotal component in the process of obtaining a wavelet decomposition specifically tailored for the analysis of human skin tissue. This method is designed to contribute valuable insights and advancements in the field of image processing and medical imaging.

In their research study, Bromiley et. al. [12] Introduced a novel approach aimed at enhancing the precision of skin disease detection. Their innovative methodology involves the integration of rapid skin disease detection techniques with the fusion of two distinct image segmentation processes to precisely identify skin lesions. A pivotal aspect of their work is the proposal of a novel function designed for capturing colour variation images and facilitating border recognition. These functions are particularly valuable in the context of images acquired using smartphones, offering a promising avenue for improved skin lesion diagnosis.

In the realm of comparative analysis employed within the context of colour and textural features, K. Wang [13] implemented a specific methodology. His research revealed a nuanced understanding of how colour features interact with other factors in producing outcomes. Notably, Wang observed that colour features in isolation tended to yield suboptimal results. However, when integrated with complementary factors, their performance improved significantly. Wang also undertook meticulous adjustments to the results within the global and local methodologies. In the global approach, he achieved a commendable sensitivity of 96% alongside a specificity of 80%. Meanwhile, within the local methodology, his efforts yielded a remarkable sensitivity of 100% and a specificity of 75%. These findings underscore the intricate interplay of colour and other features in the analytical domain, shedding light on the potential for synergistic enhancements in outcome quality.

In their research paper, Ahmad and colleagues [14] present a novel approach to diagnosing Erythemato-Squamous illnesses. They propose a Feature Selection technique that utilizes a Linguistic Hedges Neural-Fuzzy classifier. Their method, employing three clusters and incorporating 18 fuzzy rules, was subjected to rigorous performance evaluation across four training-testing partitions. The results revealed outstanding classification accuracy, achieving a Root Mean Square Error of 6.5139e-013 for the 80–20% training–test partition.

In their research work [15], Sunday and Hossain introduced an innovative approach for the diagnosis of erythemato-squamous diseases, wherein they advocated the adoption of an extreme learning machine (ELM).

Their research involved a comprehensive comparative analysis, juxtaposing the outcomes of ELM against those derived from a conventional artificial neural network. The investigation yielded substantive insights, unequivocally demonstrating that the ELM exhibited superior attributes, including exceptional learning speed, commendable generalization performance, and an inherent simplicity of implementation. These findings contribute significantly to the body of knowledge surrounding the application of ELM in medical diagnostics, shedding light on its potential as a powerful tool for efficient and effective disease identification.

In their study [16], F. Bapko and L. Kabri harnessed the power of artificial neural networks to meticulously ascertain the presence of a diverse array of skin conditions, achieving an impressive diagnostic success rate of 90%. Furthermore, their investigation delved into the identification of distinct characteristics unique to areas afflicted by skin cancer, shedding light on critical insights within this domain of medical research.

In their comprehensive examination of a decision-support system predicated on the semantic analysis of melanoma images, Karol et. al., [17] harnessed the capabilities of Artificial Neural Networks (ANNs) and Support Vector Machines (SVMs) for the purpose of classification. After a thorough exploration of various kernel functions in SVMs, their study culminated in the discernment that the linear kernel, when employed within a support vector machine framework, yielded the most superior results in terms of classification accuracy and performance. Their meticulous investigation lends valuable insights into the efficacy of linear kernel SVMs within the context of melanoma image analysis, demonstrating the significance of this finding for the broader field of medical image classification.

In their study, Rouhollah and Mohammad [18] utilized an intelligent system for the diagnosis and prediction of oral disorders, including conditions such as Lichen Planus, Leukoplakia, and Squamous cell carcinoma. The results of their research revealed a remarkably low training error of 0.0199. Similarly, Stephen et al. [19] harnessed the power of Support Vector Machine to enhance the diagnosis of melanoma. Their findings demonstrated that this approach achieved a noteworthy average sensitivity of 0.86 and specificity of 0.72, which plays a pivotal role in supporting clinical decision-making processes. These research outcomes underscore the effectiveness of these intelligent systems in the realm of medical diagnosis and signify their potential to significantly impact the field.

To elucidate the feature extraction process employed in this research paper, J. Abdul et al. [20] leveraged the 2D Wavelet Transform technique. Subsequently, for the crucial task of classification, the researchers employed a Back-Propagation Neural (BPN) Network. This network effectively partitioned the available dataset into two distinct categories: malignancy and non-cancerous cases. It is noteworthy to mention that within the field of dermatology, a widely accepted and practiced guideline is the ABCD rule, which serves as a fundamental reference point for evaluating skin lesions.

III. Methodology

The approach that will be employed in this study to categorize and comprehend different skin illnesses as the following is the process:

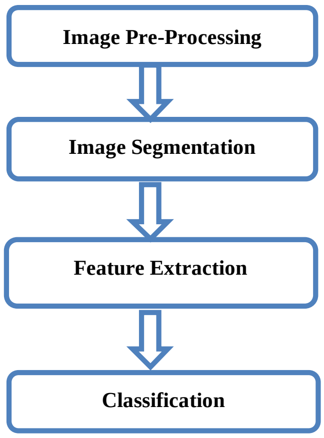

Fig. 1 Block Diagram of Skin Diseases Detection System

A. Image Pre-Processing

In most cases, the picture that is utilized for image pre-processing is an index image, so RGB skin photos must first be converted to index images before further processing. Here, we apply image conversion methods to the acquired image, such as converting an image of diseased skin illness into a binary image. In order to use the most recent image obtained for additional processing. We prepare an obtained image for further use by making it acceptable for additional image pre-processing operations. The primary goal of picture pre-processing is to improve the quality of the photos. Images have undergone several adjustments as part of the quality improvement process, including noise removal from a selected image, edge detection, edge shaping, brightness, contrast, hair removal, cropping, and resizing. Our primary goal in this stage is to improve the image, so we first remove any unnecessary components from the processed image. Next, we adjust the image matrix and remove any noise from the image.

B. Image Segmentation

A digital image is actually divided into a number of pieces throughout this procedure. To make analysis and generating a useful and relevant image easier, the real work of image segmentation and histogram plotting is done using equations (1) and (2). This image is then utilized to extract features. The thresholding approach is one of the earliest and most basic strategies used in this procedure.

C. Feature Extraction

In fact, by taking this action, we are reducing the resources required to interpret a substantial amount of processed data. In the segmented image, we abstract the texture, colour, and geometry of the image. Regularity, smoothness, medium rate, aspect ratio, parameter, compactness, boundary and edge detection, among other things, are some of the texture's main attributes. Simply said, a texture is a highly complex visual pattern made up of major entities and subordinate entities with traits like brightness, colour, slopes, size, etc.

D. Classification

To distinguish malignant melanoma from other skin conditions, a classifier is used. Artificial Neural Network (ANN)-based classifiers are employed based on the computational simplicity. In the realm of decision analysis, decision trees [21] serve as graphical representations that delineate choices and their associated potential ramifications. These decision trees exhibit a tree-like hierarchical structure, commencing with a root node that subsequently branches into child nodes. Within a decision tree, three distinct types of nodes are discernible: chance nodes, decision nodes, and end nodes. Chance nodes, denoted by circular shapes, encode the probabilities of various outcomes. End nodes signify the ultimate results of particular decision paths, whereas decision nodes, characterized by square shapes, signify pivotal decision points that necessitate choices. A system for detecting the presence of a disease and classifying it, if it is, is known as a skin disease detection and classification system. Decisions made based on features gathered utilizing feature extraction methods form the basis of categorization [22].

IV. Soft Computing Techniques

A. Artificial Neural Networks (ANN)

The structure and operation of biological neural networks in the brain serve as the basis for the mathematical model known as an artificial neural network (ANN), also known simply as a neural network. A number of artificial neurons, or nonlinear processing units, are connected to one another by weights in an ANN, which can be trained and predicted. By changing weights, ANN can "learn" a task. ANNs have been effectively employed to solve classification problems in a variety of domains, including biology, medicine, industry, control engineering, software engineering, environmental analysis, and economic and social applications [23]. A feed forward ANN model known as a multilayer perception is widely utilized to address a variety of issues. The most general-purpose and widely used neural-network paradigm at the moment is the back propagation network, also known as a multilayer network, which trains the network using the gradient descent method.

B. Support Vector Machine (SVM):

For classification and regression analysis, supervised learning models called support vector machines are used. It is a classifier that is frequently used in bioinformatics. In higher dimension future space, a support vector machine creates an ideal hyper plane with the equation $wT\ x + b = 0$. This uses the largest available margin to distinguish data from different classes. The margin is the separation between an ideal hyperplane and a vector (for example) that lays a close second. The decision function $f(x) = \text{sign}\ (wT\ x + b)$ is used for classification, where x stands for the test data variables and w and b are plane coefficients. SVM performs best when creating hyper planes in the so-called feature space Z, a high-dimensional space, as opposed to the input space. In a higher dimensional space, an ideal separation hyper plane can be created by substituting the dot product of data points with a kernel function [23].

C. Image Processing-Based Technique:

Arnal Barbedo [24] studied various classification techniques for both human and plant skin disease detection. By using innovative approaches that make use of image processing, the signs of illness are discovered on stems or leaves. The main objective of the plan is to increase the rate of detection while identifying, measuring, and categorizing the infection. But despite using a greater number of illnesses, the approach failed to detect sickness. Skin conditions that could be bacterial, fungal, allergic, enzyme, or other were exceedingly damaging to the skin and could spread if not precisely identified as soon as feasible. It is now essential to precisely identify the type of sickness at an early stage and control it by taking the necessary safeguards. Therefore, the core of image processing and a genuinely effective method was automatic image analysis. It becomes important for delivering the quantitative information connected to skin diseases, especially in the medical industry. Therefore, during therapy, demonstrated to be a useful early warning system for potential issues. Today, it was necessary to accurately detect disease without penetrating the body; as a result, digital images of the diseased skin region were simply acquired by the camera and could be processed using image processing tools. Numerous image processing tool sub-techniques were in use and had a significant impact on research. Megha Tijare [25] has created an effective algorithm for classifying disorders using image processing software.

V. CONCLUSION

Therefore, the integration of advanced image processing techniques for feature extraction and machine learning algorithms holds immense promise in revolutionizing skin disease diagnosis, making it more accessible, cost-effective, and efficient, ultimately contributing significantly to reducing mortality rates, curbing disease spread, and mitigating skin disease progression. This study has refined various parameter values from infected skin conditions including psoriasis and acne that were obtained using the active contour method. This paper encompasses an analytical approach involving surveys and interviews with skin treatment and disease specialists. The system comprises two primary components: 1) Image Segmentation and 2) Feature Extraction.

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